



IP PARIS



## LMS Seminar series 2024 – 25

### Mathematical modelling of cardiac perfusion and surrogate modelling towards clinical translation

**Speaker:** Hao Gao, University of Glasgow

**Date:** October 03, 2024

**Venue:** Amphi 104 (Pole Meca)

#### Abstract

Personalised cardiac models have the potential to improve clinical diagnosis and risk prediction for patients with heart diseases. However, there still many challenges to be resolved for their applications in clinical decision making. In this talk, I will focus on two aspects: poroelasticity and surrogate modelling. Sufficient myocardial perfusion plays a pivotal role in maintaining normal pump function. While the development of a comprehensive myocardial perfusion model remains particularly challenging as it requires the incorporation of complex interactions across different spatial scales and physical domains. I will firstly present a poroelastic immersed finite element framework to model left ventricular dynamics in a three-phase poroelastic system composed of the pore blood fluid, the skeleton, and the chamber fluid. We then couple a coronary circulation to this poroelastic immersed finite element framework for myocardial perfusion in left ventricle. It is expected that such a coupled myocardial perfusion and coronary flow model will have the potential to deepen our understanding of myocardial dysfunction due to perfusion deficiency. In the second half, I will switch to surrogate modelling of cardiac mechanics for real-time clinical decision-making. Recent efforts have focused on integrating machine learning and cardiac modelling together to create robust and reliable predictive models with significantly reduced computational cost compared to classical numerical methods. I will present our recent progress on emulating cardiac models using machine-learning based surrogate approaches, including Gaussian process and Graph Neural Network.

#### About the speaker

Dr. Hao Gao is a senior lecturer in applied mathematics at School of Mathematics and Statistics, University of Glasgow. He obtained his bachelor's and master's degree in theoretical and applied mechanics from Fudan University, then pursued his PhD in computational biomechanics at Brunel University. After finishing his PhD, Dr. Gao spent one year in University of Strathclyde on cardiac magnetic resonance imaging process, then moved to University of Glasgow as a research fellow working on image-based cardiac modelling, including mitral valve, myocardial mechanics, perfusion and surrogate emulation. Dr. Gao is a key member of the SoFTMech centre funded by UK EPSRC at University of Glasgow, leading a group of researchers towards clinical translation using mathematical models.

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